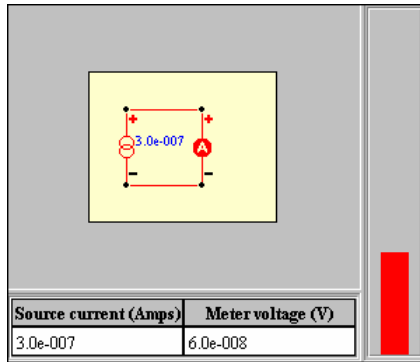# Worksheet for Exploration 30.4: Galvanometers and Ammeters

An ammeter measures current through a device and therefore must be in series with whatever element you want to find the current through. In this animation, we will contrast the behavior of ideal and real ammeters by exploring the way a basic galvanometer works and finding how you can build an ammeter using a galvanometer **(voltage is given in volts and current is given in amperes)**. Restart.

A galvanometer is a very sensitive meter that deflects when a small amount of current passes through it. (The current often goes through a coil that induces a magnetic field which causes an indicator needle to move. We use a red indicator bar instead of a needle.) In the galvanometer animation, you can enter a source current and push the "gavanometer" button. The current source is shown using two interlocking circles, ───⊙⊙───. The indicator bar on the right shows the maximum current that can pass through the galvanometer without damaging the instrument.

a. Change the source current so that the indicator is at 50%. What is the current through the galvanometer and the voltage drop across the galvanometer? (This voltage drop is due to the internal resistance of the coil.)

Galvanometer current (I) = _____

Voltage drop across galvanometer = _____

b. What, then, is the maximum current that should go through the galvanometer to just get the red bar to 100% of the screen?

Maximum current = _____

c. What happens if you exceed the maximum current rating?

We see that a galvanometer is a very sensitive current meter. They are often rated not by the maximum current, but by the internal resistance and the associated voltage drop at the maximum current.

d. Show that the internal resistance of this galvanometer is 0.2 Ω and the voltage drop at maximum current is 0.2 µV.

i. Using V=IR, find the internal resistance of the galvanometer:

For maximum current (in part b, above), V = _____

Suppose we want to use a galvanometer to measure currents up to 1mA. We know that we want full-scale indication (bar at 100%) at 1mA and half-scale at 0.5 mA and so we need for our meter to be made up of the galvanometer plus a resistor in parallel. This configuration is called an ammeter. For the galvanometer to just read full-scale at 1 mA, only 1 µA of current can go through the galvanometer and the other 999 µA must go through the parallel resistor.

e. If the voltage drop is 0.2 µV, what value does the resistor in parallel need to have?
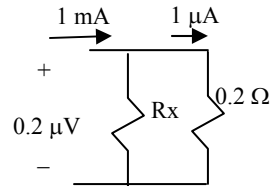
$$R_x = \underline{\hspace{3cm}}$$

f. Try the value (for R_x) and then test by adjusting the power supply to see if you get the appropriate indication over the range of values (e.g., you should get half-scale indication for a source current of 0.5 mA, 80% of the bar would indicate a source current of 0.8 mA, etc.). Here use the "ammeter" button.

g. What would the ideal value of the internal resistance for an ammeter be and why?